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PREFACE

S. MITTNIK
Department of Economics, State University of New York at Stony Brook, Stony Brook, NY 11794-4384, U.S.A.

Although there had been attempts in the mid 1950s and in the latter half of the 1960s considerable progress had been made in connection with economic growth problems, it has been only since the early 1970s that system-theoretic concepts became increasingly applied to economic modelling problems.[1] The attractiveness of mathematical system theory arose from the fact that it offers a unifying framework for modelling dynamic systems. In addition to this powerful conceptual framework, it provides a wide range of tools useful in applied work. System-theoretic techniques enter predominantly two stages of economic modelling efforts: the stage of model construction and the stage of model application in accordance with the modelling objectives. It was, in particular, the latter stage which led to joint research efforts between economists and engineers. In May 1972 the first *NBER Stochastic Control Conference* was held at Princeton University. The engineering side followed in July 1973 by organizing the first *IFAC/IFORS International Conference on Dynamic Modeling and Control of National Economies* which was held in Warwick, England. Even then, as the motto of the conferences and the presented papers indicate, economists were primarily attracted by the optimal control methods developed by "control scientists".[2] The interest in these dynamic optimization techniques appeared to recede somewhat with the advent of Lucas's critique, arguing that agents' decision rules are not invariant under interventions.[3] Despite this criticism, dynamic optimization represents now an important tool in economic modelling.[4] The significant impact of system theory on this area of research may explain the fact that economists frequently equate system theory with dynamic optimization theory.

In the early 1970s, there was an increasing number of contributions emphasizing the potential of system-theoretic techniques in the model construction stage[5] and, eventually, triggering a second wave of influx after the "control theory wave". In particular, the advantages of Kalman filtering methods in constructing empirical economic models were soon recognized. Although the Kalman filter has become almost a standard tool in econometrics, and algorithms can be found in many graduate econometrics textbooks, new areas of applications are still being discovered. Only very recently, the econometric model building toolbox has been enriched by another system-theoretic concept, namely stochastic realization theory, which integrates model selection and parameter estimation.[6]

The objective of this and subsequent volumes of special issues on *System-theoretic Methods in Economic Modelling* is to initiate and/or intensify dialogs between researchers and practitioners within and across the disciplines involved. In view of the growing spectrum of promising system-theoretic concepts and techniques as well as specific economic applications, the following statement made by K. D. Wall and J. H. West in 1974 (p. 873) is—in a slightly altered form—as valid today as it was then:[7]

> "Most [systems] engineers and theorists are not sufficiently cognizant of the special economic issues involved. Conversely, most economists or econometricians do not fully understand the generality and unified approach to dynamic systems afforded by [system] theory. Both areas have considerable amount of mutual interest and much can be learned from the other."

This first volume brings together papers exhibiting a wide range of system-theoretic techniques and applications to economic problems. The papers have been divided into two groups, following roughly—but not necessarily—the above classification into the construction and application stages of economic modelling. The first group focuses on the identification of dynamic and static systems, while the papers in the second group address dynamic optimization problems.

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Notes

[1]For a brief review of the earlier attempts and their comeback almost twenty years later, see M. Aoki, *Optimal Control and System Theory in Dynamic Economic Analysis*, pp. 4–6, Elsevier, New York (1976). Control-theoretic approaches to economic growth problems, as well as further references on this topic, can be found in A. R. Dobell, Some characteristic features of optimal control problems in economic theory, *IEEE Trans. autom. Control* **AC14,** 39–48 (1969). A review of more recent applications in econometric modelling is given in E. J. Moore, On system-theoretic methods and econometric modelling, *Int. econ. Rev.* **26,** 87–110 (1985).

[2]Selected papers presented at this conference appeared in the October issue of *Ann. econ. soc. Measur.* **1,** No. 4.

[3]R. E. Lucas, Econometric policy evaluation: a critique, in *The Phillips Curve and Labor Markets* (Eds K. Brunner and A. H. Meltzer), pp. 19–46, North-Holland, Amsterdam (1976). For related discussions see also F. E. Kydland and E. C. Prescott, Rules rather than discretion: the inconsistency of optimal plans, *J. polit. Econ.* **85,** 473–491 (1977), and G. A. Calvo, On the time consistency of optimal policy in a monetary economy, *Econometrica* **46,** 1411–1428 (1978).

[4]See, for example, T. J. Sargent, *Dynamic Macroeconomic Theory*, Harvard University Press, Cambridge (1987).

[5]See, for example, R. K. Mehra, Identification in control and econometrics; similarities and differences, *Ann. econ. soc. Measur.* **3,** 21–47 (1974).

[6]The following monographs are largely devoted to this topic: M. Aoki, *Notes on Economic Time Series Analysis: System Theoretic Perspectives*, Springer, Berlin (1983); P. W. Otter, *Dynamic Feature Space Modelling, Filtering and Self-Tuning Control of Stochastic Systems*, Springer, Berlin (1985); and M. Aoki, *State Space Modeling of Time Series*, Springer, Berlin (1987).

[7]K. D. Wall and J. H. West, Macroeconomic modeling for control, *IEEE Trans. autom. Control* **AC19,** 862–873 (1974).